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Most of all I thank Conlon Nancarrow for cooperating in every possible respect, for his hospitality in Mexico City, for becoming a warm friend, for enduring dozens of answerless questions about music he had written decades earlier, for spending years of his life punching piano rolls with no guarantee that anyone would ever care about their contents, and for having the phenomenal imagination to create a body of music the likes of which no other individual could have ever dreamed up.

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The music: general considerations

Compared to the musical traditions of Africa, India, and Indonesia, European classical music has always been rhythmically limited. As soon as American composers broke away from Europe following World War I, they made an aggressive attempt to remedy this deficiency. They found themselves thwarted, however, first by the difficulty of notating extreme rhythmic complexity, then by the greater obstacle of getting performers to execute their rhythms accurately. Henry Cowell (1897–1965), an early ethnomusicologist and the twentieth century's first great theorist of rhythm, invented a new rhythmic notation in an aesthetically revolutionary treatise titled *New Musical Resources*, published in 1930 though written some dozen years earlier. He was interested in superimposing rhythms derived from equal divisions of a common beat: for example, dividing a whole note into five, six, and seven equal parts, and playing the different beats all at once. This exercise would effectively layer three tempos simultaneously, in ratios of 5:6:7. Addressing the problem of execution, he wrote,

An argument against the development of more diversified rhythms might be their difficulty of performance . . . Some of the rhythms developed through the present acoustical investigation could not be played by any living performer; but these highly engrossing rhythmical complexes could easily be cut on a player-piano roll. This would give a real reason for writing music specially for player-piano, such as music written for it at present does not seem to have.¹

Later, in a record review, he repeated his suggestion even more forcefully:

To hear a harmony of several different rhythms played together is fascinating, and gives a curious esthetic pleasure unobtainable from any other source. Such rhythms are played by primitives at times, but our musicians find them almost if not entirely impossible to perform well. Why not hear music from player piano rolls on which have been punched holes giving the ratios of rhythms of the most exquisite subtlety?²

Cowell's idea was prophetic, but for once in his life, he left an experiment untried. That task fell to another composer: Conlon Nancarrow from Texarkana, Arkansas.

Nancarrow read *New Musical Resources* in 1939 in New York, as he was preparing to leave for Mexico City to avoid harassment by the American government

for his Communist Party connections. Cowell's words fused with a childhood memory – Nancarrow had grown up with a player piano in the home – and sparked one of the strangest careers in the history of music. Like so many other American composers in the 1930s, Nancarrow had been working to extend music's rhythmic vocabulary. Like others, he quickly came to the point at which classical musicians refused to play his music, or at least to play it well. But Nancarrow, self-exiled in Mexico City far from the musical mainstream, took a step few other composers would or could take: he learned to produce his music independently of performers. In 1948, he bought a player piano and embarked on an amazing series of now more than fifty Studies for Player Piano, exploring more aspects of rhythmic superimposition and tempo clash than any other composer had dreamed of doing.

The name Conlon Nancarrow has entered music dictionaries only recently, though he had gained an underground reputation in America by the early sixties. Many contemporary music enthusiasts are unaware of him, let alone general audiences. Where his name is found, regularly, is on radical young composers' lists of the musicians who influenced them most. In Europe he is regarded as one of the greatest living composers. In 1981, after finding his recordings in a Paris record store, seminal Hungarian avant-garde composer György Ligeti wrote of Nancarrow, "This music is the greatest discovery since Webern and Ives . . . something great and important for all music history! His music is so utterly original, enjoyable, perfectly constructed, but at the same time emotional . . . for me it's the best music of any composer living today."³ An obvious part of Nancarrow's obscurity stems from his medium: only those who visit his Mexico City studio have heard the works in their "live" form. Too, printed dissemination of his music has been slow. Between 1977 and 1985, thirty-one of the Studies were published by Peter Garland in his *Soundings* journal from Santa Fe. So far only a handful of analyses have been printed, and those not always accurate. Even musicians aware of Nancarrow by reputation and the few out-of-print recordings do not nearly realize the extent of his compositional achievement. Exploring that achievement will be the purpose of this book.

Overview

Although seventy-five percent of Nancarrow's works are for one instrument, and that an eccentric one, his output is as varied in style, form, and weight as that of any other major composer. He has written light-hearted blues numbers like the Studies for Player Piano Nos. 3, 10, and 45; perfect miniatures like Nos. 4, 6, and 32; contrapuntal tours de force like Nos. 7 and 37; works that independently articulate the concerns of the European avant-garde, like Nos. 20, 23, and 29; formal jewels like Nos. 11, 24, and 36; abstract structuralist sound-patterns like Nos. 5 and 28; virtuoso spectacles like No. 25; experiments in temporal irrationality like Nos. 33, 40, and 41; one chance piece, No. 44; and, in Nos. 24, 32, 33, 36, 37, 40, 41, 43, and 48, a string of essays exploring different aspects of canon

with a thoroughness that rivals Bach's *The Art of Fugue*. Is Nancarrow, like Webern, a painstaking craftsman of elegantly-wrought structures? Yes: listen to Studies Nos. 20, 24, 32, 36. Or is he, like Ives, a wild-eyed eclectic tossing jazz and modernist gestures into crashing cacophonies? Yes again: listen to Studies Nos. 25, 35, 41, 48. One must return to the piano music of Liszt and Busoni to find so many diverse strategies brought to one medium by a single composer.

Although most of Nancarrow's works are very brief (only seven of the Studies run over seven minutes), they do not *sound* brief, largely because of their sheer speed. Within a three-minute study Nancarrow often fits a mass of notes that would have sufficed Liszt for a twenty-five minute sonata. Study No. 36, for example, is under five minutes, but its score is fifty-two pages black with ink. Consequently, the music demands unusually intense listening, not, as in Webern's music, because events are extremely localized, but because so much happens, so many sections go by so quickly. Nancarrow's complete works could be heard in seven hours, but within half that time the listener would be as exhausted as though he had consumed Mahler's ten symphonies in a gulp.

Despite his miniaturization, however, Nancarrow's sense of structure is invariably large-scale. He rarely works as Webern does, mirroring one motive with another (Nos. 7, 35, and 41 are exceptions); instead he is like Stravinsky, with great blocks of material that resist deconstruction. Whereas Beethoven composed long works from short motives, Nancarrow has made brief works from large chunks of melody or rhythm. The fifty-four note melody of the Canon X (Study No. 21), the 120-chord progression of No. 11, the four-page isorhythmic tune of No. 12, the interminably nonrepeating duration-series of No. 20, the twenty chromatic segments of No. 41, the long rhythmic row of No. 45c. – these are the irreducible data of Nancarrow analysis; sometimes they can be broken down into subsidiary patterns, elsewhere they seem to have sprung from his head in a protracted flash of inspiration. In fact, his blocks of material are often larger than Stravinsky's, but they do not lead to longer works because they are juxtaposed *simultaneously*, not successively as in *Le sacre du printemps* – a pivotal work, one should keep in mind, in Nancarrow's development as a musician.

Experimentalism

Experimental is a word popularized by John Cage for the new music of the 1950s, though it was used by Nancarrow as early as 1940. Cage's definition of an experimental work was "an act the outcome of which is unknown." The idea of a piece of music being experimental is perhaps drawn from an analogy with science: something never done before is tried in order to gain new knowledge or test a hypothesis. So defined, the term has been controversial, not always welcomed by the composers to whom it has been applied (Varèse and Ashley, for example).

Some of Nancarrow's studies fit the experimental definition better than most of Cage's music does, since outside Nancarrow's work the sheer physical effects of

the subtle time relationships he has worked with are completely unknown. Nancarrow often gives the impression that once *he* has heard what an experiment sounds like, there is little need for further attention to it; he has avoided repeating himself to an extent almost unknown among other major figures. With the arguable exception of Study No. 49, there is not a piece in Nancarrow's mature output that does not contain some new idea or twist he had never tried before. The number of compositional ideas he has used only once or twice is astounding. For example (unfamiliar terms on the following list will be fully explained in later chapters):

- 1 A pitch row split into discrete segments (Study No. 1)
- 2 A pitch row using internal repetitions of a pitch cell (No. 4)
- 3 A texture built up from motives that repeat nonsynchronously, i.e., out of phase (also involving every note on the piano without duplication) (No. 5)
- 4 An isorhythm (repeating rhythmic series) altered by systematic changes of tempo (No. 6)
- 5 Different isorhythms played at once (No. 7)
- 6 A piece divided simultaneously into equal-length sections by texture changes, and into a *different* number of equal sections by melodic structure (No. 11)
- 7 Polyphonic use of isorhythm in which the *color* (pitch row) and *talea* (rhythmic row) are associated differently in each contrapuntal line (No. 20)
- 8 A canon in which the voices gradually reverse roles (No. 21)
- 9 A palindromic canon (No. 22)
- 10 A correspondence between tempo and register (Nos. 23, 37)
- 11 Rhythmic canon in which the canonic voices have wildly disparate textures (No. 25)
- 12 Use of a 12-tone row as harmonic determinant for triadic music (No. 25)
- 13 Accelerating isorhythmic canon (No. 25)
- 14 A steady beat as a perceptual yardstick for changing tempos (Nos. 27, 28)
- 15 A "scale" of tempos proportional to a pitch scale (Nos. 28, 37)
- 16 Interrupted (and resumed) acceleration (No. 29)
- 17 A tempo canon whose voices theoretically converge *outside* the canon's time frame (No. 31)
- 18 Isomorphic transformation of a duration pattern to simulate a tempo canon (No. 33, *Two Canons for Ursula*)
- 19 Tempo changes within layered tempo contrasts (No. 34)
- 20 An entire movement played at the same time with itself at a different speed (No. 40)
- 21 An isorhythm accelerated by subtracting from the individual durations (No. 42)
- 22 Aleatory tempo canon (No. 44)
- 23 Use of Fibonacci durations to create the same rhythmic motive at different tempos (No. 45)

- 24 Irrational, unnotatable isorhythm (Nos. 45, 46, 47 – originally one work)
- 25 Structural acceleration within a tempo canon (No. 48)
- 26 Tempo canon in which voices are timed to converge *not* all at the same time (String Quartet No. 3)

The list could go on, and it does not even touch the innovations he has returned to repeatedly: irrational tempo relationships, glissandos with selected notes sustained, or the idea of tempo clashes at ratios of 4:5, 24:25, 60:61, and so on. Perhaps it is exactly because Nancarrow was not running around writing orchestra pieces, violin sonatas, song cycles, and commissions like most successful composers that his invariant medium forced so much variety from him. If so, it is a good argument for limitation of medium. Any four of these ideas might have sustained another composer's entire technical vocabulary. Aside from Cage and Stockhausen, what other twentieth-century musical minds have been so fertile?

Nietzsche remarked that Schopenhauer's philosophy was the conception of a young man of twenty-six, and that it forever partook of that period of life's specific qualities. Nancarrow arrived at the preconditions of his music at thirty-five, not twenty-six, but similarly his music has always evoked the young rebel. At eighty-two, he has yet to reach sedate elegance or avuncular predictability. This is partly because of his music's harsh, bristling timbre, in conjunction with the methodical rhythmic wildness that makes his most disciplined structures sound ferocious, untamed. But it is also because of Nancarrow's unremitting experimentalism, his refusal to repeat himself. He is the eternal revolutionary.

Tempos, rhythmic ratios, and the harmonic series

One of Cowell's aims in *New Musical Resources* was to bring to rhythm the same structuring possibilities that had already been applied to pitch, in fact, to draw an analogy between the two (a procedure that Babbitt, Boulez, and Stockhausen would later apply in deriving serialism from twelve-tone technique). The rhythmic theory of Cowell's book was fueled by the insight that pitch intervals and cross-rhythms are manifestations of the same phenomenon, differentiated only by speed. That is, the higher pitch in a purely-tuned interval of a perfect fifth vibrates at a rate one and a half times that of the lower pitch, illustrating a ratio of 3:2. A triplet rhythm over a duple accompaniment, then – three against two – is simply the transfer of the "perfect fifth" idea from the sphere of pitch to that of rhythm.

As the vibrations of a tone are slowed down, the pitch becomes lower, and if the frequency descends lower than a threshold of about sixteen cycles per second, the vibrations are no longer heard as pitch, but as a steady beat. Cowell had a machine invented for him that would keep two sirens tuned at a constant ratio as he slowed them down and sped them up, and he was delighted to hear proof that, as a perfect fifth became slow enough, it turned into a rhythm of three against two. The idea inspired Cowell to hypothesize a system of rhythmic divisions in which each duration is a division of a fundamental duration. *New Musical Resources*

Example 1.1 Diagrams from Henry Cowell's *New Musical Resources*

The image contains two sets of musical notation. The top set consists of three staves (treble, alto, and bass clefs) with various rhythmic patterns and groupings. Below this set is a small diagram labeled 'Vibration ratio' showing a treble clef staff with a whole note and a half note. The bottom set also consists of three staves with rhythmic patterns and groupings. Below this set is another small diagram showing a treble clef staff with a whole note and a half note, with a '4' written below it.

included diagrams relating simultaneous tempos to triads, based on a fundamental "C-tempo" symbolized by four or eight notes per measure (Example 1.1). Always quick to follow speculation with practice, Cowell wrote a piece, *Quartet Romantic*, about the same time as *New Musical Resources*, in which the four performers play their lines in diverse and ever-changing tempos determined by the pitch ratios in a simple tonal chorale. Unplayable for six decades after its composition, *Quartet Romantic* was first recorded in 1978 by players listening through headphones to a computer clicktrack that provided their tempos.⁴

This was all the theoretical background Nancarrow needed to start experimenting. His first work not written for human hands, the Rhythm Study No. 1, relates all of its rhythms to two different simultaneous tempos, 120 and 210, related by a 4:7 ratio. Four to seven is the ratio of a purely-tuned minor seventh interval, C to a slightly flat B \flat . The next explorations were among tempos related by ratios of three, four, and five. From here the chronological progression of Nancarrow's tempo ratios creeps up the harmonic series. The group of seven canonic studies, Nos. 13 through 19, use ratios related to the major or minor triad: expressed as pitch, 3:4 gives the perfect fourth, 4:5 the major third, 3:5 the major

sixth, and 12:15:20 a first-inversion minor triad, i.e., G B E. The 5:6:7:8 ratio of Study No. 32 is analogous to an E G B \flat C seventh chord, the 17:18:19:20 of No. 36 to a cluster, C \sharp D D \sharp E. The 24:25 and 60:61 ratios of Studies Nos. 43 and 48, respectively, represent closely spaced harmonics in the higher octaves. Study No. 33 uses the irrational $\sqrt{2}:2$ ratio of the equal-tempered tritone; Nos. 5 and 50 use the 5:7 ratio that is the smallest integral approximation of a tritone. And in Studies Nos. 40 and 41 Nancarrow went beyond algebraic square roots to the transcendental numbers e and π , whose pitch analogue is irreducible dissonance. In the more recent Study No. 49 Nancarrow has returned to the 4:5:6 ratio of the root-position major triad.

It is worth comment that, although so much of Nancarrow's conception of compositional technique derives from his early contact with *Le sacre du printemps*, the rhythm problems suggested by Cowell pointed to a direction of rhythmic development opposite to that of Stravinsky. One of Stravinsky's feats in *Le sacre* was the extenuation of *additive* rhythm, the grouping of small durational units into irregular meter progressions such as 6/8, 5/8, 9/8, 7/8, 3/8, and so on. Cowell's harmonic-series idea comes from the opposite method of *divisive* rhythm, taking a larger unit (e.g., a whole note) and dividing it simultaneously or successively into equal parts of various lengths. In the middle decades of this century, divisive rhythm was associated with Schoenberg and his followers, additive rhythm with Stravinsky and the neoclassicists. The pairing was somewhat paradoxical: Schoenberg clung to more traditional rhythms partly because his pitch usage was counterintuitive. (This is what Boulez and Stockhausen objected to: they felt a systematic pitch language demanded a systematic rhythmic language.) Stravinsky, on the other hand, stayed closer to the harmonic series in his often-pentatonic melodic language and used rhythm as the radical, counterintuitive element.

The Schoenberg/Stravinsky controversy was one of music's most bitter feuds, and it was raging when Nancarrow began the early studies. Nancarrow has always professed solidarity with the Stravinsky camp, and by the time Schoenberg's followers succeeded in expunging Stravinsky's influence from American compositional practice, Nancarrow had retired to his Mexican isolation. Yet both types of rhythm are found in Nancarrow's music, and it is a kind of watershed in his development when, *notationally*, divisive rhythm wins out over additive, between Studies Nos. 5 and 6. More importantly, however, Nancarrow was the only composer to thoroughly synthesize the two opposing conceptions of rhythm. (Other Americans, notably Roger Sessions and Arthur Berger, wrestled with the contradiction on the pitch front.)

In that respect, Nancarrow's Study No. 1 is prophetic. Paying homage to Cowell's divisive rhythm, Nancarrow notated 4/4 meter in one staff as equal to another's 7/8. His rhythmic groupings within those meters, however, are largely additive, changing between articulations of 3, 4, and 5 beats. Study No. 5, a textbook case, shows how the two rhythmic types intersect. Here the ostinatos group sixteenth notes into repeating duration patterns of 14 7 14 21 7 14 and 15 5

10 5 10 10 20. Nominally these rhythms are additive, but the meter, 35/16, is chosen to integrate beats of 5/16 and 7/16 durations; in short, a 35/16 "hyper-measure" is divided into five equal beats in one voice, seven in another. Like No. 5, Studies 3, 4, 7, 10, 11, and 12 are notated with all voices in the same tempo, organized around an eighth- or sixteenth-note subdivision acting as a common denominator. In No. 6 Nancarrow returns to a large measure divided into three, four, and five in the respective voices. As his tempo ratios increase, notation with a common sixteenth note denominator quickly becomes unwieldy, and he later unites voices via common *multiples*, or hypermeasures,⁵ wherever necessary and possible.

Cowell's rhythmic system, especially in his *New Musical Resources* examples and less so in the *Quartet Romantic*, had the limitation of its *periodicity*, the fact that after every few beats all voices re-convene in a simultaneous attack. By retaining additive rhythm within each voice, Nancarrow circumvented that limitation. Once he had marked off tempos across manuscript paper with a template, he no longer needed to draw common barlines to keep voices together, and began to change meters within each tempo. In Study No. 14, the first such instance, the meters fit the accentuation pattern, resulting quasi-randomly from a rhythmic process. Starting with No. 24 (one of his most original works on many counts and still his most rhythmically elegant solution), Nancarrow returns to truly additive rhythms occurring in different voices whose tempos effectively divide large hypermeasures into varying numbers of equal beats. Each line considered in itself uses additive rhythm, but the various lines are integrated by an overall divisive rhythmic structure.

The problem with divisive rhythm was its dependence on a too-predictable periodicity. The charge made against additive rhythm was that it had no analogy in pitch, that its use relegated pitch and rhythm to separate structural worlds. (In search of an analogy, Babbitt attempted to bypass additive rhythm in serialism by serializing rhythmic positions within a 6/8 or 12/16 metric grid.) Nancarrow combined the best of both worlds. Beginning with Study No. 24 and continuing with increasing freedom through his most recent studies, he has preserved the energetic, unpredictable feel of additive rhythms within the context of a tempo system related to the pitch relationships of the harmonic series. Inspired by Stravinsky, challenged by Cowell, he is the only composer who completely integrated the microrhythms of one with the macrorhythms of the other, the only one to *solve*, rather than bypass, the Schoenberg/Stravinsky rhythmic dilemma. Nancarrow achieved this feat, of course, at a price few composers would have been willing to pay: he sacrificed the possibility of performance by humans.

Mechanical rhythm

The rhythmic problems broached in Nancarrow's player piano music anticipated many that have arisen in computer music (as well as many more that computer

composers have *not* yet worked with). So much has been done now with the electronic sequencing of rhythm that we know much more about mechanically precise rhythm than was known when Nancarrow began punching rolls. Recent studies suggest that absolutely metronomic rhythm is not only humanly impossible, but undesirable from a listening standpoint. The relevant research has been summarized by Jonathan D. Kramer:

Performers do not render even the simplest of rhythms exactly as notated. For example, we should expect a half note followed by a quarter note to be played in the ratio 2:1 . . . But in fact, the 2:1 ratio is virtually never heard, except when electronically produced. Psychologists Ingmar Bengtsson and Alf Gabrielsson found that, in 38 performances of a Swedish folksong in 3/4 time with most measures containing the half/quarter rhythm, the actual ratio averaged about 1.75:1.⁶

Music meant to be performed, Kramer goes on to say, sounds stiff when mechanically sequenced by a computer, because the ear perceives absolute regularity as awkward and artificial.

What implications do such studies hold for the mechanical perfection of Nancarrow's rhythms? It is true that, in the more "abstract" studies (Nos. 25, 33, 35, 41, and 48, for example), there is little sense of beats falling with the intuitive predictability of a physical gesture. However, in a way Nancarrow's entire output has been a response to that challenge. Like the computer researchers who develop "random deviation" programs to give computerized rhythms a more lifelike feel, Nancarrow has from the very beginning used the player piano to *recreate* rhythmic liberties taken in performance that no notation could convey. In the studies based on the stride piano rhythms of blues (Nos. 3, 4, 10, 45), he has implicitly acknowledged that jazz pianists hardly ever play a dotted rhythm in a 3:1 ratio; instead, Nancarrow often divides his beats into ratios of 3:2, 5:3, or 8:5, all divisions based on the Fibonacci series, related to the intuitively pleasing Golden Section as well as closer to live performance practice. The 4:5 alternation of tempo in the ostinato of Study No. 6, the unevenly divided isorhythms of Nos. 7 and 11, the notes bouncing between tempos in No. 45b, are brilliant models for creating the *appearance* of performance irregularity within regular systems. The player piano has always been for Nancarrow an opportunity to achieve rhythmic deviations Western notation does not easily acknowledge.

Still, as irregularly as Nancarrow may *subdivide* his beats, the beats themselves remain more regular than any pianist would try to play them, and this is a central fact of Nancarrow's tempo conception. Once one has committed himself to working with simultaneous tempos in ratios as close as 14:15:16 (Study No. 24), any interpretive deviation from strictness is out of the question. The slightest *tenuto* or *rubato* in one voice has to be also reflected in the others if the integrity of their relationships is to be maintained; as soon as one robs a note in the 14 tempo of even 1/15th of its value (far less than the 1.75:1 ratio cited by Kramer), it becomes identical to the notes in the 15 tempo, and the point of the exercise has vanished.

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What implications do such studies hold for the mechanical perfection of Nancarrow's rhythms? It is true that, in the more "abstract" studies (Nos. 25, 33, 35, 41, and 48, for example), there is little sense of beats falling with the intuitive predictability of a physical gesture. However, in a way Nancarrow's entire output has been a response to that challenge. Like the computer researchers who develop "random deviation" programs to give computerized rhythms a more lifelike feel, Nancarrow has from the very beginning used the player piano to *recreate* rhythmic liberties taken in performance that no notation could convey. In the studies based on the stride piano rhythms of blues (Nos. 3, 4, 10, 45), he has implicitly acknowledged that jazz pianists hardly ever play a dotted rhythm in a 3:1 ratio; instead, Nancarrow often divides his beats into ratios of 3:2, 5:3, or 8:5, all divisions based on the Fibonacci series, related to the intuitively pleasing Golden Section as well as closer to live performance practice. The 4:5 alternation of tempo in the ostinato of Study No. 6, the unevenly divided isorhythms of Nos. 7 and 11, the notes bouncing between tempos in No. 45b, are brilliant models for creating the *appearance* of performance irregularity within regular systems. The player piano has always been for Nancarrow an opportunity to achieve rhythmic deviations Western notation does not easily acknowledge.

Still, as irregularly as Nancarrow may *subdivide* his beats, the beats themselves remain more regular than any pianist would try to play them, and this is a central fact of Nancarrow's tempo conception. Once one has committed himself to working with simultaneous tempos in ratios as close as 14:15:16 (Study No. 24), any interpretive deviation from strictness is out of the question. The slightest *tenuto* or *rubato* in one voice has to be also reflected in the others if the integrity of their relationships is to be maintained; as soon as one robs a note in the 14 tempo of even 1/15th of its value (far less than the 1.75:1 ratio cited by Kramer), it becomes identical to the notes in the 15 tempo, and the point of the exercise has vanished.

What happens, any lover of this music feels, is that the complexity of Nancarrow's tempo relationships compensates for the subconscious, note-to-note complexity lost in the act of mechanical reproduction. (Nancarrow does not even see it as compensation: "When romantic music is played in straight quarter notes and eighth notes," he says, "I find that kind of music boring even *with* the human performance. That's why I don't like romantic music.")⁷ Any attempt to hear three lines of contrasting tempo as each keeping its own steady beat focuses the attention so keenly that other perceptual concerns, even those one is more accustomed to, fall by the wayside. As for the desirable ebb and flow of tempo that takes place in performance, this may have been the subconscious motivation behind Nancarrow's acceleration studies (Nos. 8, 21, 22, 23, and 27, plus the finale of the String Quartet No. 3), in which different lines accelerate and retard not only together, but independently of each other. And the late, unmeasured Studies Nos. 41, 45, and 48 approach a chaotic rhythmic energy close to that of free improvisation, as though Nancarrow were still searching to incorporate some kind of "body rhythm" into his mechanical music. As Kramer notes,

a human performance of one of Nancarrow's more complex studies (if we can imagine the incredible pianist needed to accomplish such a feat) might well be less thrilling than the normal player-piano rendition. The effect of Nancarrow's music thrives not on performance mastery, but on the mechanistic precision of, for example, simultaneous tempos in the ratio of $\sqrt{2} : 2$ [Study No. 33]. With such a complex ratio, there is no room for performer nuance. Any deviation from exactitude would sound like an error, not like an expressive interpretation.⁸

Nancarrow also faces the complaint heard by many composers of tape music, that there is no interpretive variety, that the music sounds the same at every performance. As he once put it,

I am amazed that most people who object to the nonhuman element in computer music or in the player piano have no objection to a Shakespeare sonnet, for example. That sonnet has always remained the same over the centuries. No one suggests it should be changed by a new performance. A painting stays the same forever. The same is true of other works of art. But somehow music is supposed to be different all the time.⁹

The Studies for Player Piano constitute a grab-bag of experiments that perceptual psychologists should have fun with for decades. Nevertheless, in his most recent works for live performers, such as the String Quartet No. 3 and the *Two Canons for Ursula*, Nancarrow (with the help of the Arditti Quartet and Ursula Oppens) has shown that tempo relationships as simple as 3:4:5:6 do leave room for expressive interpretation. Who knows how far future composers and performers will dare to adventure toward even more distant relationships?

Pitch

In 1987 the author interviewed Pierre Boulez, who had only recently been introduced to Nancarrow's music by Elliott Carter and was still excited about the

discovery. "For me it was very interesting," Boulez said, "because the rhythmical structure is really very well thought out. Unfortunately, the pitch vocabulary does not follow."

Is Boulez's complaint legitimate? There is a temptation to think of Nancarrow what was once thought of Charles Ives, that he is a revolutionary *naïf*, innovative in certain areas, but unsophisticated in respects necessary for greatness. Part of this impression comes, no doubt, from Nancarrow's self-imposed isolation, so parallel to that of Ives. But one must keep in mind that Nancarrow was twenty-eight when he moved to Mexico, and that he had already spent considerable time with some of the best, most advanced musical minds of his era: Henry Cowell (through his book), Nicolas Slonimsky, Roger Sessions, Walter Piston (perhaps even Schoenberg). Traces of twelve-tone thinking crop up in Nancarrow's music from time to time (Study No. 25 uses a twelve-tone row), and the early studies in particular show a sophisticated manipulation of pitch rows. If Nancarrow departed from the chromatic, systemic pitch usage of his contemporaries, it was not because he lacked the technique to manage them, but because he eventually found them inappropriate to what he was doing. One could hardly charge that he found complex pitch systems too much trouble to invent: any composer who would balk at a sizeable expenditure of effort would never have finished punching out even the first five piano rolls.

Whether Nancarrow's pitch thinking has been on the same level as his rhythmic thinking is not a question that can be answered in generalities, because he has made pitch serve so many different purposes. There are studies in which, by Nancarrow's own admission, pitches are little more than an arbitrary string with which to manifest the tempo structure. The fifty-four-note row of Study No. 21 seems makeshift, No. 15 is melodic without being memorable, pitch in No. 22 is a blur, and the recurring seventh chords in No. 33 are far from subtle. One of Nancarrow's departures from the rest of the century's music is his resuscitation of materials that romanticism had rendered banal, such as triads and scales. Always intended to render some rhythmic point more easily audible, they lend an unnerving freshness to his music, though an ear trained to subtle Boulezian sonorities might find them simply awkward.

However, had Nancarrow tried to construct tempo canons from the pitch systems typical of Boulez's *Le marteau sans maître*, he would have defeated his own purposes and become incomprehensible. In the Sonatina and Study No. 1 he goes to ingenious lengths to make inversions and retrogrades invoke the bittersweet intervals of blues. In the other early studies his harmonies authentically recapture a blues style of piano playing. Nancarrow has written catchy, even hummable tunes in Studies Nos. 6, 7, 11, and even 41. The offbeat, never-quite-repeating pitch sequence of No. 4 was a brilliant inspiration. One test of masterful counterpoint should be that no line draws undue attention from the others, and the echoing lines in the softer canons of No. 24 blend as well as anything in Palestrina or Bach. If the purpose of pitch in a canon is to make the canonic structure clear, one could

hardly ask for a better melodic subject than that of No. 36, which sweeps the ear into the temporal process. The falling fifths of No. 37 reveal the temporal structure in a way a row could not. And there are many passages where pitch becomes merely a component of timbre, such as the elaborately contoured glissando-arpeggios in Studies Nos. 25, 41, and 48; the filling out may be *analytically* arbitrary (up to a point, after which it is quite systematic), but the ear is satisfied.

In short, one has to answer Boulez both yes and no, and put things in perspective. How sophisticated Nancarrow's pitch systems are depends on what he is trying to achieve. The means are always subservient to the end, a principle even Boulez should go along with.

Harmony

Boulez's complaint may be fair to the extent that harmony is the least developed aspect of Nancarrow's music. In the conventional sense – as simultaneous pitches approached via a confluence of voices – harmony may hardly be said to exist. The striated tempos, the predominantly staccato attacks often mean that exact simultaneities are infrequent and, when they do occur, are too brief to notice. Much of Nancarrow's music moves too quickly for harmony to register. Nevertheless, his use of harmony is perfectly suited to his contrapuntal and rhythmic purposes.

Nancarrow's early harmonies derive from jazz and blues. The ostinatos of Study No. 3, for example, pass repeatedly through C, F, and G, but the change of chord hardly affects what notes lie in the melody, and the same is true of the blues progression that opens No. 10. Rather than color a melody, Nancarrow usually turns blues chords toward a static pandiatonicism. The same is true of the tonal canons, such as Nos. 16 and 19, where Nancarrow aims not for consonance or dissonance, but for a key vaguely defined by the omnipresence of its seven scale steps and blurred by the gradual introduction of foreign pitches. This marks his early Stravinskian influence, similar in method not only to the pandiatonicism of that master's neoclassic music, but to the directionless harmonies of *Le sacre*, which alternate without moving toward perceptible goals. The sense of harmonic *motion* from one set of pitches to another is almost absent in Nancarrow's music, except perhaps in the slowly progressing repeated-note Studies Nos. 20 and 29 and in No. 28's key-rise through the chromatic scale.

In Nancarrow's mature music, especially from Study No. 25 on, but already in Studies Nos. 1, 5, 6, 7, 9, and 12, chords appear not as products of voice-leading or tonal function, but almost always in parallel, as textural extensions of a single line. To reiterate a melody more forcefully, or to highlight it, Nancarrow will articulate it in (to list them in increasing order of emphasis):

- 1 thirds
- 2 octaves
- 3 parallel major triads
- 4 parallel seventh or ninth chords

Example 1.2 Harmonies from Studies Nos. 25, 33, and 45c

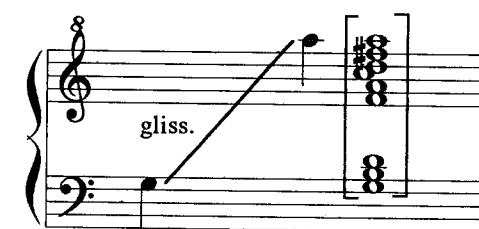
No. 25



No. 33



No. 45



- 5 larger chords generated from a single interval, or
- 6 chords which, when condensed within an octave, fill out a contiguous diatonic or chromatic scale segment.

To put it another way, it is rare that adjacent chords are functionally differentiated. Nancarrow's equalizing tendency is most notable in the middle Studies, especially

Example 1.3 Pitch motives combining a minor third with a major or minor second

Sonatina



Study No. 3A



No. 3B



No. 4



No. 10



No. 41



String Quartet No. 3



Example 1.4 Melodies following a rising perfect fourth with a rising minor third

Study No. 8



No. 11



No. 24



No. 35



No. 43



Nos. 24, 25, and 33. Many of the crashing chords of No. 25 comprise every note in a diatonic scale, No. 33 makes its five-note chords both from piling up minor sevenths and major ninths and from spread-out diatonic or whole-tone scale segments, while No. 45c piles up triads polytonally (Example 1.2).

After Study No. 35, Nancarrow largely loses interest in complex individual sonorities, and late studies such as Nos. 41a, 42, 43, 44, 45, 48, 49, and 50 are remarkable for their near-exclusive reliance on the major triad as harmonic material. It is a measure of Nancarrow's independence from his time that, during decades in which all but the most reactionary composers avoided major triads as irretrievably banal and exhausted, he used them in good faith and invested them with a function that carried no shadow of their earlier meaning in tonal music. In the midst of his swirling polyphony, those innocent triads never sound incongruous: each triad expresses its individual root in a way no other chord could. Except where Nancarrow explicitly desires a dense, massive effect (such as in Nos. 25 and 33), his chords invariably lend clarity to the polyphonic structure.

Example 1.5 Melodies turning on a minor third

Study No. 27



No. 31



No. 32



No. 37



Example 1.6 Triad-plus-minor-third motives

Study No. 43



No. 48



Example 1.7 Passages emphasizing a minor third

Study No. 20



No. 23



No. 40



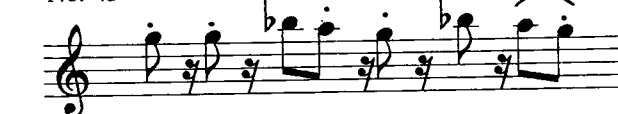
No. 41



No. 42



No. 45



No. 49



Example 1.8 Figures with an ascending major scale and descending minor scale

Sonatina



String Quartet No. 1



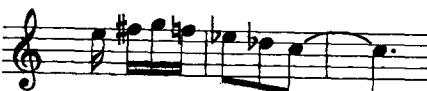
Study No. 6



No. 7



No. 35



No. 41



No. 46



Melodic tendencies

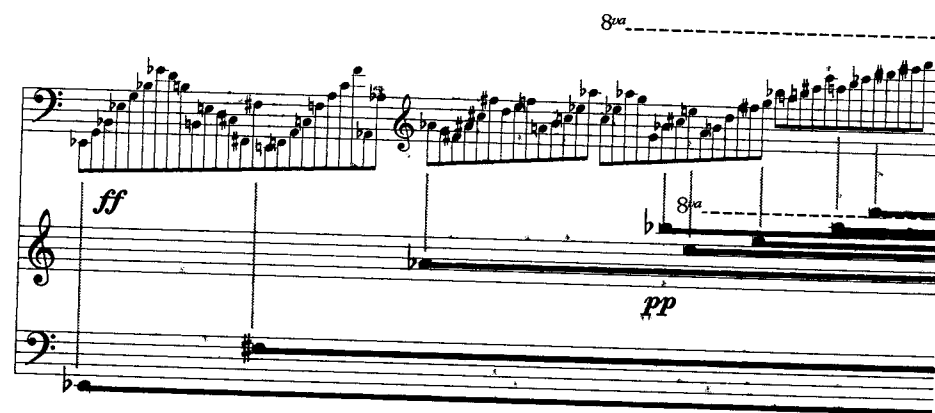
Historically, composers have reused forms over and over (sonata form, variations, da capo aria) and varied the melodies within them. Nancarrow's use of certain melodic formulas is so consistent, from the 1941 *Sonatina* to *Contraption No. 1* of 1993, that he can almost be said to have done the opposite: reuse the melodies over and over and vary the forms around them. Every commentator has noted the importance of the minor third in Nancarrow's melodies, and it appears in many recurring contexts. The prevalent early form is combined with an adjacent half or whole step to build a ubiquitous motive (Example 1.3). Another common form is a rising perfect fourth followed by a rising minor third and often a descending second, in a pattern A-D-F-E or A-D-F-E \flat (Example 1.4). Often the melody turns around minor thirds, as in Example 1.5; or follows a triad with a minor third as in Example 1.6. And, increasingly in the late works, the minor third is stripped down to a mere alternation or obsessive 1-2-3 repetition (Example 1.7). In addition, one of Nancarrow's most characteristic figures is the combination of a major scale segment ascending and a minor scale segment descending (Example 1.8). These figures are so ubiquitous throughout the music that they will be cited in chapters 3 through 10 without special explanation.

Other common figures, such as the superfast glissando or major triad arpeggio, arise in Nancarrow's late music as an enlivening textural trick to which the player piano is well suited. One type of figure, common in Studies Nos. 25, 41, and 48, resists simple description: a figure of extremely fast notes outlining a jagged contour, often filling up a chromatic pitch-space or drawing a tortuous line through the piano's range (Example 1.9). For convenience's sake, this figure has frequently been referred to as simply an "arpeggio" in the following analyses, on the premise that, in a dissonant or atonal context, a jagged chromatic line could serve as the nonlinear arpeggiation of a complex chord. However, Nancarrow takes amusement in having once overheard someone comment at a concert that another composer's work included a "Nancarrow lick." Perhaps there is no better term for the figure than that.

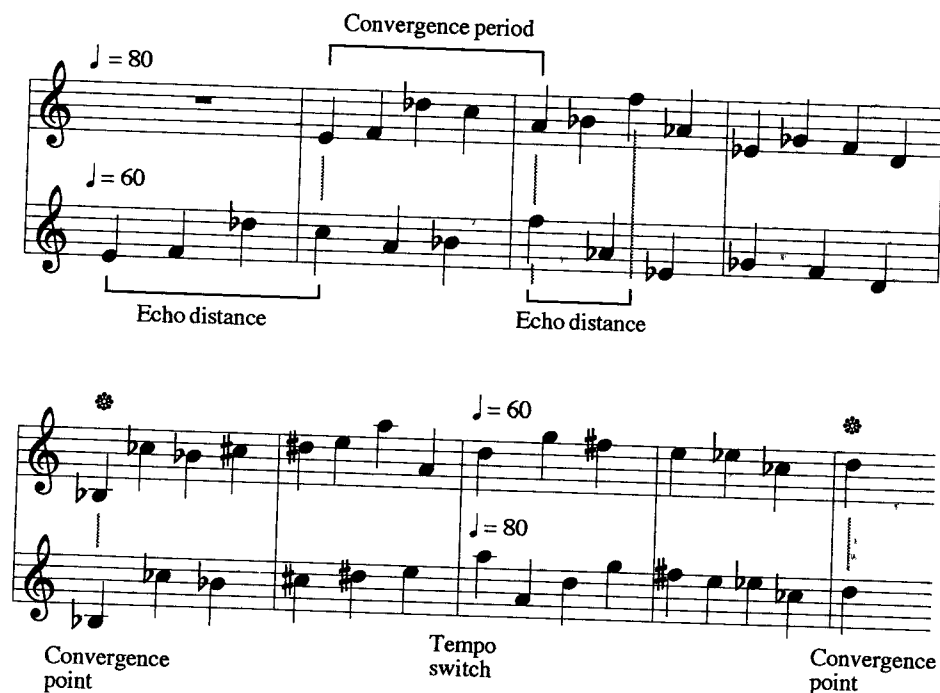
Tempo canon and its formal results

For exploring the problem of several tempos at once, Nancarrow resorted to several forms, some of them prevalent in the 1930s. Arch form, common in Bartók, became a favorite: Study No. 22 is palindromic, No. 1 is nearly so, and the second half of No. 43 runs back through the first half's ideas in reverse order. Studies Nos. 36 and 41 are looser arch forms, with striking asymmetrical features. Half of an arch form can be a linear crescendo: Studies Nos. 5, 28, 29, 42, and 48 increase in speed, texture, or both to a climactic final chord. As an ex-jazz trumpet player, it is natural that Nancarrow used a variation form over an ostinato in Studies Nos. 2, 3, 10, 11, and 45. Studies Nos. 24 and 29 alternate A and B

Example 1.9 Study No. 41b, "Nancarrow lick"



Example 1.10 Tempo canon terminology



sections, swinging between two processes that interrupt each other. Study No. 7 is the only one that can be construed as a sonata-allegro with first and second themes, and many of Nancarrow's forms are *sui generis*. But the device to which he ultimately devoted the most work and thought was tempo canon: transpositions of the same melody played in different tempos at the same time.

Nancarrow is not the first composer to write tempo canons, or (as they were called in the Renaissance) mensuration canons – in which two or more voices

play the same material at not only different transposition levels but at different tempos as well – but he is the first to write so many different kinds as to necessitate a special terminology. Inherent to the technique of the tempo canon are various events resulting from the canon's structure to determine the overall form. The most central I have chosen to call the *convergence point* (often abbreviated as CP in the analyses), the infinitesimal moment at which all lines have reached identical points in the material they are playing. In the late studies, from No. 24 on, this is usually either the climax or the end of a canon, though occasionally a convergence point will fall inaudibly on a rest, and in a few cases not until *after* the canon is over. Nancarrow's ways of marking the convergence points exhibit astounding ingenuity.

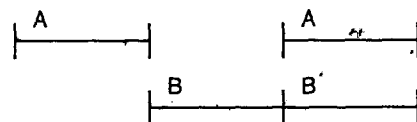
Another major, but less audible, event is the *tempo switch*, a device in which Nancarrow switches the fastest line to the slowest tempo and vice versa, so that the line that has been lagging catches up with the one that has been pulling ahead. By mathematical necessity, the tempo switch always occurs halfway between two convergence points.¹⁰ The perceptual datum by which the ear keeps track of these changes I call the *echo distance* – the temporal gap between an event in one voice and its corresponding recurrence in another. In a tempo canon in which the convergence point is in the middle, for example, the echo distance will grow shorter and shorter as the convergence point is approached, reach zero at the convergence point, then grow progressively longer as it moves away. To calculate echo distance as a precise number of beats requires specifying which voice the relevant beat-unit refers to; for example, in a 4:5 canon an echo distance of five beats with reference to the faster voice equals four beats with reference to the slower. Proportionality between phrase length and echo distance is essential to the compositional technique of the late canons.

In the canons in which meter changes frequently, it sometimes becomes necessary to speak of the *convergence period*, the hypermeasure that exists between (potential) simultaneous attacks in voices moving at different tempos. For example, in a canon at the ratios 14:15:16 (No. 24), one convergence period has fourteen beats in the slowest voice, fifteen in the middle voice, and sixteen in the fastest. Keeping track of convergence periods makes certain calculations easier. For example, in canons based on superparticular ratios (i.e., 4:5, or 9:10), the echo distance will increase (if after the convergence point) or decrease (if before) by one beat per convergence period.¹¹ In such a case, the echo distance will approximate n beats at a point n convergence periods from a convergence point. In three canons, however – Studies Nos. 33, 40, and 41 – Nancarrow uses irrational tempo relationships, so that, theoretically, no notes in one voice will *ever* coincide with those in another. Under these conditions, the concept of convergence period becomes inapplicable. The greatly simplified example of a hypothetical 3:4 canon in Example 1.10 should fix these essential concepts in mind.

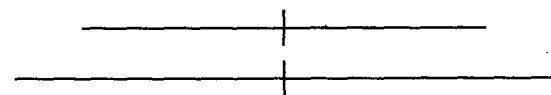
Nancarrow has written more than two dozen canons; no two are alike in structure, and where they differ most importantly is in the number and disposition

Example 1.11 Morphology of Nancarrow's canons

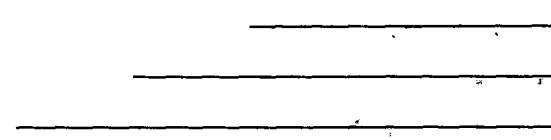
Study No. 16 (not a true canon)



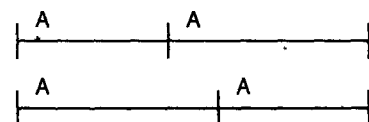
Study No. 14 - Canon 4/5



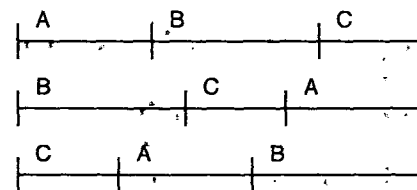
Study No. 19 - Canon 12/15/20



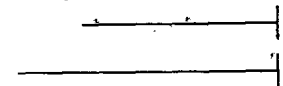
Study No. 15 - Canon 3/4



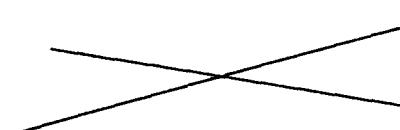
Study No. 17 - Canon 12/15/20



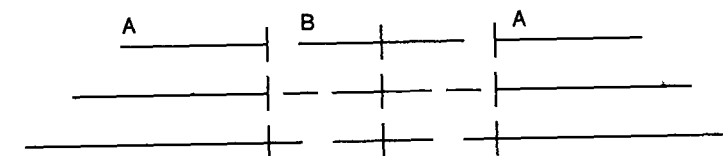
Study No. 18 - Canon 3/4



Study No. 21 - Canon X

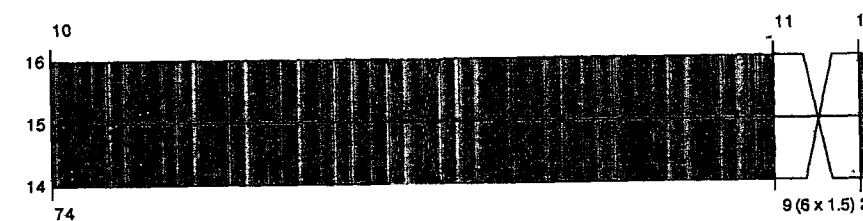
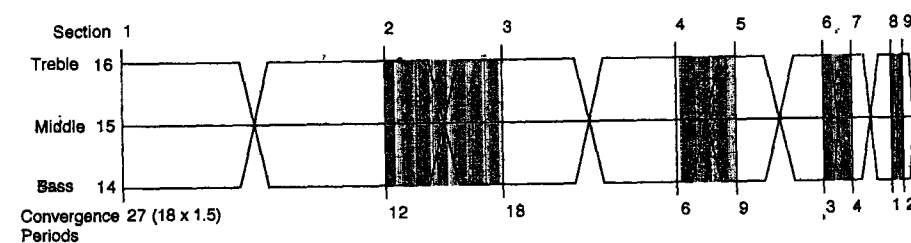


Study No. 22 - Canon 1 1/2% / 1 1/2% / 2 1/4%

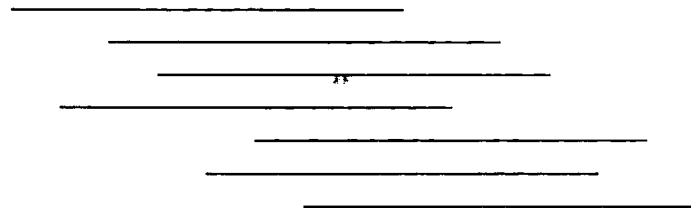


Study No. 24 - Canon 14/15/16

□ slow, pp ■ fast, ff

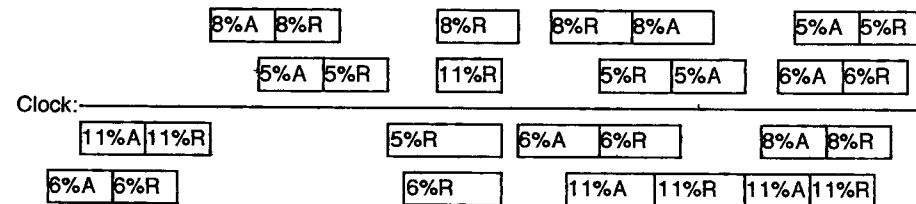


Study No. 26 - Canon 1/1 [1/1/1/1/1]

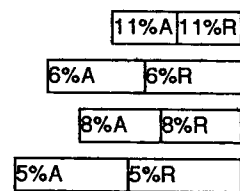


Study No. 27 - Canon 5%/6%/8%/11%

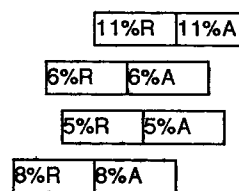
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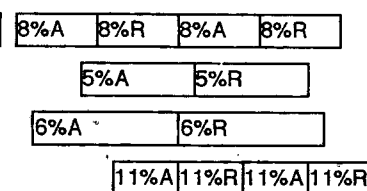
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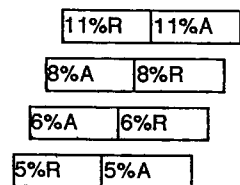
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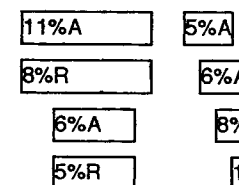
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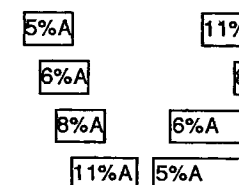
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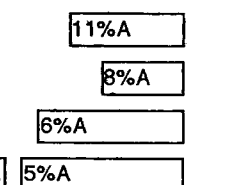
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Section 7:

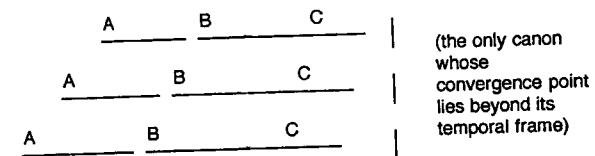


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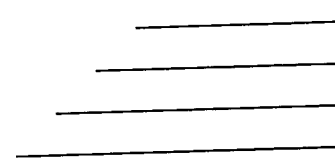


Durations not strictly proportional

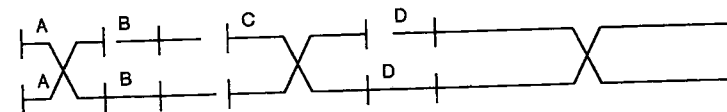
Study No. 31 - Canon 21/24/25



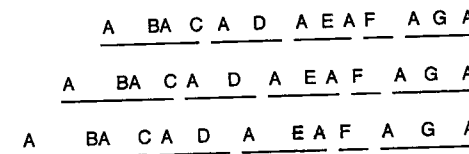
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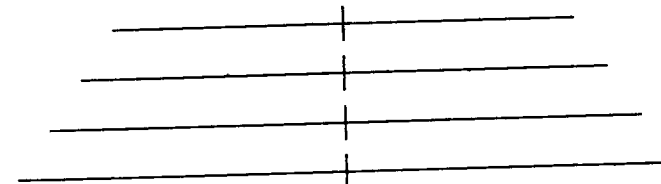
Study No. 33 - Canon (square root of 2)/2



Study No. 34 - Canon $\frac{9}{4/5/6} / \frac{10}{4/5/6} / \frac{11}{4/5/6}$

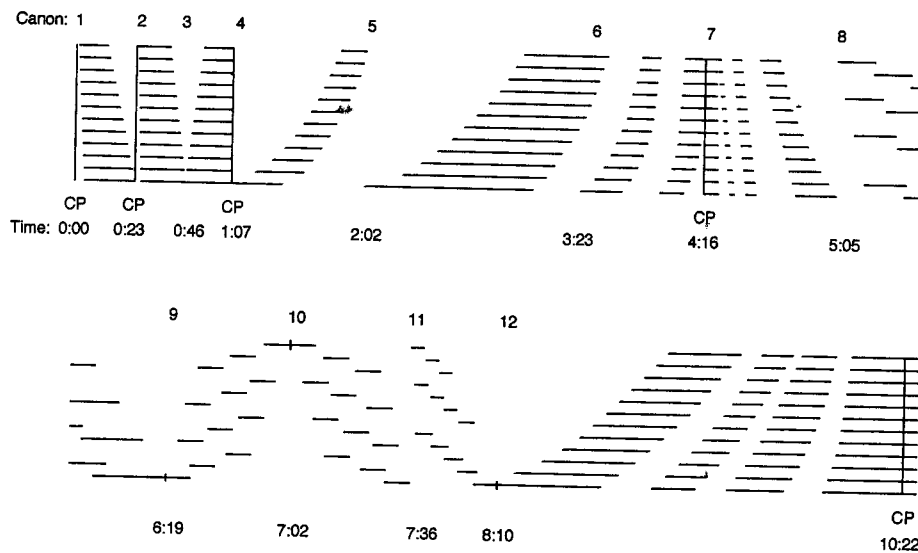


Study No. 36 - Canon 17/18/19/20

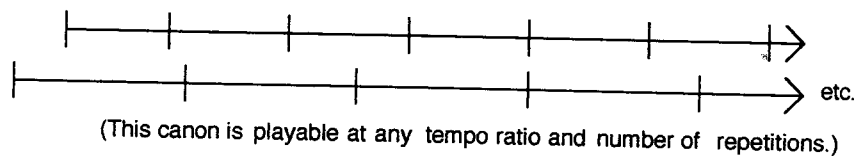


The music of Conlon Nanarrow

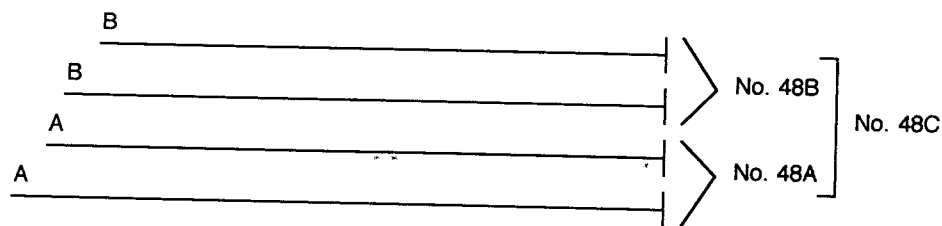
Study No. 37 - Canon $150/160^{5/7}/168^{3/4}/180/187^{1/2}/200/210/225/240/250/262^{1/2}/281^{1/4}$



Study No. 44 - Aleatory Round



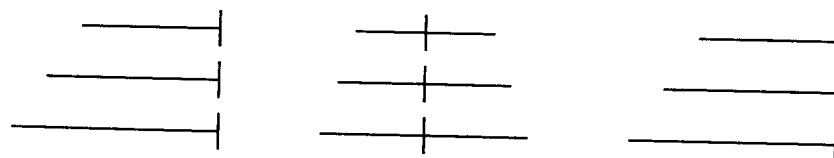
Study No. 48 - Canon 60/61



Study No. 49A

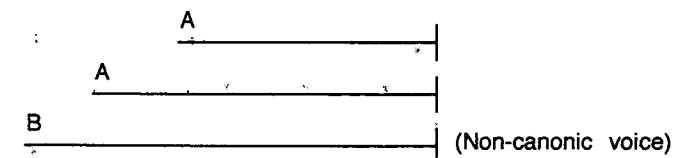
No. 49B

No. 49C - Canons 4/5/6



The music: general considerations

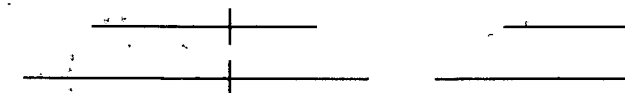
Study No. 50 - Canon $\frac{5}{7}$ (Second movement, Piece for Small Orchestra No. 2)



Two Canons for Ursula

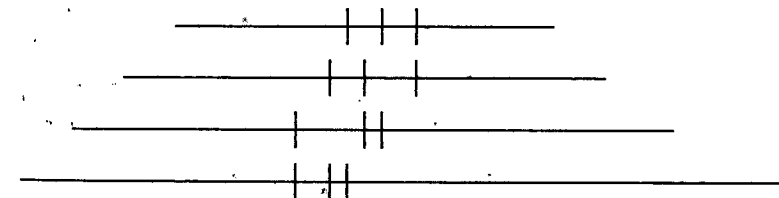
Canon A - $\frac{5}{7}$

Canon B - $\frac{2}{3}$

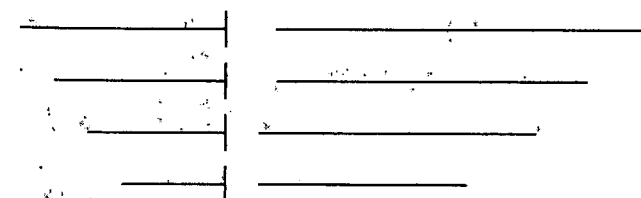


String Quartet No. 3 - Canons 3/4/5/6

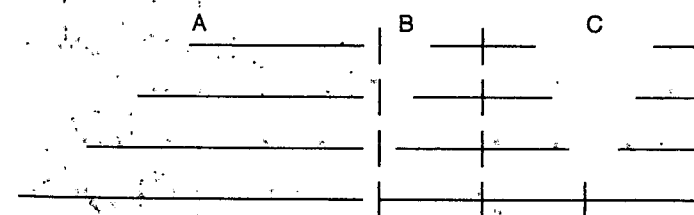
Movement 1:



Movement 2:



Movement 3:



(The final canon is an acceleration canon, $\frac{3}{4}/\frac{4}{5}/\frac{5}{6}/\frac{6}{7}$.)

of convergence points, the number of voices, and tempo switches. The morphological outlines of Example 1.11 provide an abstract skeleton of each canon. Convergence points are marked by vertical lines, tempo switches are marked by diagonal lines forming an X, and sections of differing material – usually separated in the music by an extracanon rest or change of transposition level – are indicated by letter. (Note that the length of each diagram is related to the complexity of the form, not to its length proportional to the other studies. Lengths within each diagram are approximately proportionate.)

Nancarrow has far from exhausted the structural possibilities. For instance, he has never written a canon with a convergence point only at the beginning, nor one in which the tempo switches are not reciprocal (each moving to the other's tempo). The first composer to throw the field open, he has left plenty of terrain for future practitioners. Nevertheless, it seems safe to predict that the ingenuity that he has applied to finding rhythmic ratios for his tempo canons will not soon be surpassed.

Timbre

"No recorded image of his compositions ever will reproduce the overwhelming sensation of raw power and excitement," wrote Charles Amirkhajian in his liner notes to Nancarrow's 1750 Arch recordings, "generated when sitting 'in the flesh' in Nancarrow's soundproof studio in Mexico City and listening to his rolls." Nancarrow disagrees – he felt that Robert Shumaker's pristine tapes played at New Music America in San Francisco were as glorious a way to experience the music as any – but the observation is true nonetheless. Crisp, penetrating, electric, growling – these are weak adjectives for conjuring up the tumult of crashing chords, five contrapuntal lines at once, figures of hundreds of notes per second flung out by Nancarrow's modified mechanical pianos.

Of the several player pianos Nancarrow owns and has owned, the two he writes for and has used to record his works are made by Marshall and Wendell, and contain Ampico Reproducing Piano mechanisms. Nancarrow has altered the hammers of both pianos. On one, the wooden hammers have been covered with steel straps to create a brilliant, piercing sound; the hammers of the other piano are covered with leather and capped with a metal tack that strikes the strings with a milder, but still bristly tone. The strident tone that results from these modifications puts some first-time listeners off, but they make Nancarrow's humble uprights seem larger and more fierce than a concert grand. It has become apparent, too, that in composing Nancarrow has increasingly relied on the enhanced ping of his pianos. At New Music America in New York in 1989 the German composer/engineer Trimpin played his computer-driven version of Study No. 48 on two unaltered grand pianos; the sound was muddy, its contrapuntal clarity – so crystalline in Nancarrow's studio – greatly diminished. The comprehensibility of the late studies depends on his altered piano hammers.

Another feature peculiar to Nancarrow's pianos should be kept in mind. His Ampico mechanisms play only eighty-three keys of each piano, five fewer than standard, from B₀ to A₇ with the bottom two and top three omitted. (When necessary, I will indicate pitches with the system of the Acoustical Society of America, in which middle C is C₄, the highest C on a normal piano is C₈, the lowest C is C₁, and the note just below C₁ is B₀.) E₄ is thus the central note of Nancarrow's range; many of the studies systematically use all eighty-three notes, and E₄ is a frequent center of symmetry.

The Studies that use two pianos (Nos. 40, 41, and 48) were intended to take advantage of the slight timbre contrast between the two instruments. That contrast can be heard on the 1750 Arch recordings made in 1977, but by 1988 one of the pianos had fallen into disrepair, so the Wergo recordings of these studies are not made "in real time," but by playing each roll on the same piano and overdubbing them in the studio. In 1989, German chemist and player-piano hobbyist Jurgen Hocker sent his protégé, the piano mechanic Jurg Borchardt, to Mexico City to restore Nancarrow's pianos to pristine working condition.

Dynamics

Nancarrow's pianos have the capability of playing crescendos and decrescendos, but he does not use them; like Bach, he says with considerable pride, he belongs to the "terraced dynamic school." At one edge of the piano roll is a place for up to three holes that determine how much air pressure the machine uses, thus how much volume it produces. For whatever reason, these holes are designated 2, 4, and 6. Eight dynamic levels are possible, ranging from no holes to all three. In Nancarrow's punching scores, he notates those levels as (–0–), (–2–), (–4–), (–6–), (4–2), (6–2), (6–4), and (6–4–2). He rarely seems to need all eight levels in one work, however. Study No. 48a contains six dynamic levels, and in the final score Nancarrow notates (6–4–2) and (6–4) as *ff*, (–6–) as *f*, (–4–) as *mf*, (–2–) as *p*, and (–0–) as *pp*. In addition, sustain and soft pedals are available. Nancarrow notates them with dots – (. .) and (.) respectively – but hardly ever uses them.

Metronome markings

It is refreshing to realize that the only major composer whose music has been almost entirely mechanically produced is just as wary of precise metronome markings as Beethoven was. Nancarrow's markings are generally rounded off for the sake of arithmetical simplicity, not to be taken literally. If the middle voice in Study No. 24 actually followed a tempo of ♩ = 240, the piece would be over in an all-too-quick 209 seconds, instead of an already ear-dazzling 263; if, however, the marking were changed to a more realistic 191, the other tempo calculations would be needlessly complex. The speed on Nancarrow's pianos is continuously adjustable, from stopped to quite fast, and he has often changed his

mind about how fast the studies should run. To the man who insisted on the absolute precision of relative tempos in his music, absolute tempo is an intuitively relative matter.

Between the 1969 Columbia recording and the 1975 Arch recording of 1977, Nancarrow increased the speed of seven studies (by as much as sixteen and a half percent in No. 33), decreased the speed of four, and left only one unchanged. My opinion is that Nancarrow has tended to play his studies too fast, and this is especially true of the 1975 Arch discs. Nancarrow may enjoy the fireworks, or think his listeners enjoy them, but dozens of his best compositional effects could be more clearly heard at slower speeds. More than once I have played a taped study at half-speed to hear exactly what happens. And perhaps Nancarrow has come to agree; the Wergo recordings, released in 1990-91, reveal an average 10.7 percent decrease in the overall tempos of the duplicated studies. Thirty-four of the studies were slowed down by an average of twelve and half percent, some as much as thirty-three (No. 28) and twenty-seven percent (No. 29), with great improvement in comprehensibility. Only four (Nos. 15, 20, 36, and 37) are faster on Wergo, and those by less than five percent.

In addition, as Nancarrow has often noted, as the roll winds around the take-up spindle of his player pianos, the thickness of the column increases and causes a slight speed-up in the music. Philosophically, he sees this acceleration as a natural phenomenon that occurs unconsciously in most musical performance, and points to long African drumming performances as a parallel example.¹²

Working method

Once he progressed beyond tempos that could easily fit within a small convergence period, such as 3:4:5, Nancarrow needed a working method that would free him from placing barlines to connect voices every few beats. His solution was to make *templates*, long strips of poster paper on which a tempo is marked off. Over the years, Nancarrow has collected templates for dozens of tempo relationships the way just-intonationist composer Lou Harrison has collected them for indicating the string lengths of tunings on a monochord. Clearly harking back to Cowell's theories, Nancarrow identifies each template by a pitch name relating it to a basic "C" tempo; the templates he used for Study No. 42, for example, are marked in the score B \flat E D C G B \flat D to indicate tempos corresponding to ratios of 7:10:9:8:12:14:18.

Nancarrow says he always knows from the beginning what tempo relationships a piece will require. In his words,

When I got into these complex multitempo things, I'd take a blank roll, and knowing before I'd even do it how long the piece would be, and what the proportions would be, draw out those proportions on the whole roll, with the smallest value I thought I'd be needing in the piece. Then I'd take the width of the score paper, from here to here, and draw it off on the roll that size, and take

blank score paper and put all of these things on the blank paper. And then write the piece. Up to then there was no piece, just a tempo relationship.¹³

After he uses the templates to mark off tempos on manuscript paper, he sketches out the piece. From this sketch he draws a more detailed punching score, with beat numbers, dynamic markings, and every indicator he needs to punch the roll. This punching score is often a more accurate guide to what actually happens in the piece than the final score. From the punching score he transposes the notes to a piano roll, first marking off the tempos across the top edge of the roll, with the beats numbered to facilitate keeping the voices of the canon straight. (The cover of Vol. 5 of the Collected Studies in *Soundings* shows his template markings for Study No. 36.) Nancarrow works at a long table, with take-up reels at each end for the piano roll, and a wheeled chair that lets him easily move back and forth across the roll.

The punching machine has a guideline about an inch away from where the hole is actually punched; one problem with getting information from the piano roll (as I had to do with Study No. 47 because Nancarrow had lost the score) is that that gap must be continually accounted for. Once the roll is aligned, Nancarrow pulls the handle and squeezes a trigger to do the actual punching. (James Tenney notes that the handle is quite resistant, and that Nancarrow's left bicep – the handle is on the left – is much more developed than his right.) Formerly, the machine punched only one hole at a time. This made it time-consuming to punch long sustained notes, since each one required a series of holes; the piano mechanism will read a note as continuous if the holes are close enough together. Nancarrow had an attachment made, however, to punch four holes at a time, greatly speeding up the process.

The process is still heavily time-consuming, however, requiring several months to punch one of the more complex studies. Consequently, Nancarrow rarely sketches on the piano rolls, and he envies the ease with which computer composers can make alterations:

It's too much work. One of the things that appeal to me about these synthesizers is that, if you don't like something in a particular register, or if you want to put something in octaves, whatever, you just change it immediately. You don't have to punch anything. As a matter of fact, in Study No. 21, you remember where the notes get slower and slower? I didn't realize how much the slow voice would be drowned out, and I kept adding octaves to it afterward. Finally, by the end, I think I had all the octaves and you still couldn't quite hear it. For little things like that a synthesizer would be very useful.

He also has little interest in playing with the visual aspect of a roll:

A long time ago, someone who had seen these patterns said, "Why don't you make an abstract design, don't think of music, just a design?" I did it, I tried to keep from thinking of music, tried to avoid thinking of any specific scale or whatever, just an abstract design. I put it on and it sounded terrible, so I dropped that idea. The others sometimes come out interesting visually, but it's pure coincidence.¹⁴

Once when I was staring at the formidable quantity of apparatus needed to realize the Studies, and thinking of the years of diligent, even relentless labor that went into them, I remarked to Nancarrow, "It makes me feel lazy by comparison." He replied, "Well, this is lazy work – it's a desk job."

Nevertheless, although Nancarrow rarely sketches on a roll, in 1993 his assistant Carlos Sandoval found sixty-eight discarded piano rolls in his studio, representing abandoned and unfinished works. These rediscovered rolls contain a wealth of information that could lead to more detailed reconstruction of Nancarrow's working methods. For example, one of the rolls, a fairly well worked out three-section piece, had an ostinato from Study No. 2 running through one section, and the opening theme from the String Quartet No. 3 in another, two works separated by at least thirty-five years. Another roll featured the jazz duet that runs through Study No. 41, accompanied by triads and ostinatos more typical of Nancarrow's earliest studies. These incongruities suggest that Nancarrow, when strapped for an idea, rummages through earlier, abandoned works and salvages entire themes and even sections from which to build new structures. (This is what he did with the quintet he wrote for the Parnassus ensemble in 1993.) Like snapshots, the rolls capture private, playful moments: one of them has only the word "Hello" punched diagonally across it, apparently so Nancarrow could hear what the word's shape sounded like translated to sound.

Many of the rediscovered rolls use only a dozen or so pitches, vibrating in static rhythmic patterns; it seems certain that these rolls were intended not for player piano, but for the mechanized percussion orchestra Nancarrow had built and abandoned. Sandoval found the percussion instruments and their mechanisms as well, in rather deteriorated condition. It is questionable whether those percussion works could ever be reconstructed beyond the mere rhythmic scheme.

Notation

After the roll is punched, the only remaining step – and an unnecessary one, from the composer's standpoint – is to copy a final score. With the possible exception of a few electronic composers (who, prior to 1977, were forced to make scores of their created-on-tape works in order to get them copyrighted in the United States), no other composer save Nancarrow has ever had the monumental task of drawing every note in his scores in exact rhythmic proportion to all the others. From 1960 to 1965 he quit composing and labored at scoring the first thirty studies, realizing that the musical world was unlikely to take him seriously unless he put his work in a form that lent itself to analysis. The pinpoint accuracy of those scores, in terms not only of pitch but of placing notes precisely within a fluid temporal continuum, is an achievement no other composer has ever had to duplicate. (Though surprisingly few, there are mistakes in the scores, and some of the more important ones have been pointed out in the analyses, usually in footnotes. It is an indicator of Nancarrow's musical discipline that most errors are immediately obvious as such.)

Nancarrow's proportional notation sets up formidable obstacles for analysis, and they might as well be dealt with at once, rather than scattered through the following analyses. The lack of bar lines and specified relative note durations in about a third of the studies – Nos. 8, 20, 21, 22, 27, 28, 29, 41, 42, 45, 46, 48, 49, 50, and parts of 23 and 35 – gives the impression of a free, rhapsodic rhythmic inspiration. In reality, however, Nancarrow's rhythmic thinking is more often than not systematic, at least to the point of involving a contrast between underlying tempos. Most of the spatially notated scores could be renoted more precisely, though, admittedly, it would be a tremendous amount of trouble in some cases and would not make the music look more like it sounds; the convenience would be only for the theorist. Studies Nos. 8, 20, 35, 41, 42, 48, 49, and 50 have underlying beats, sometimes notated in the punching score but not in the final score, which would make renotation possible. In reproducing examples from these, I have frequently rewritten them in conventional note values, not because I consider Nancarrow's notation inadequate, but so that the reader can see at a glance the exact rhythm he intended. Only the acceleration studies and those with irrational rhythms firmly resist conventional notation.

In the spatially notated studies as they are, how does one find those systems, calculate those tempos? By measuring every last note with a ruler. How does one interpret a series of note durations expressed in millimeters as 14, 13, 9, 9, 10, 5, 16, 5, 13, 14? What the author has done, when it seemed justified by context, is assume that Nancarrow's use of the template fell short of perfect accuracy (in the final score, not necessarily on the piano roll), and that the 13s, 14s, and 16s were intended to represent notes of equal duration, as were the 9 and 10. (Introduce some 11s and 12s into the pattern, of course, and that assumption falls apart.) Even if Nancarrow *did* notate relative durations with microscopic accuracy, two notes within the same melodic line, differing in duration by a factor of thirteen to fourteen, could not be distinguished by ear except under extraordinary and specific conditions. In such a case the analyst has every reason to assume that a line of intermixed thirteen-, fourteen-, and fifteen-millimeter notes will be heard as articulating a steady beat, certainly well within the normal deviations of instrumental practice. The reader should be cautioned, though, that the integrity of the analyses of spatially notated studies is subject to my careful use of my little plastic metric ruler, and that each renotation into more specific note values has been drawn with a sigh of hope that the note lengths on the printed page accurately convey what the composer had in mind. In some cases it has been possible to confirm findings with the punching score.

For whatever reason, Nancarrow's scores since 1978 have been less carefully drawn than the earlier ones. Nancarrow graciously gave me the manuscript punching score for Study No. 48a, and my experience with it dramatized how dependent future Nancarrow scholarship will be on examination of the original manuscripts. Working at first with the final score, I made several misassumptions about the piece's rhythmic nature, and I doubt whether I would have ever

correctly determined, say, the opening change from a 21-tempo to a 20-tempo without seeing the relationship of the notes to Nancarrow's marked subdivisions. A page from Nancarrow's punching score to Study No. 48, with attendant explanation, is found in Example 8.51 (on page 230). Beethoven's sketches are intriguing for finding out how a piece developed, but Nancarrow's sketches are often essential just for finding out what he actually intended.

Helpfulness of drafts prior to the final score varies widely. Many of the early studies, for example, reveal no significant differences between the punching score and printed score. In the late studies, however, Nancarrow often includes far more specific rhythmic indications in the punching score, conveying to the final one only proportional rhythmic spacing, and that not always entirely accurate. Imposing on Nancarrow's hospitality as much as I dared, I examined the punching scores to Nos. 23, 25, 41, 42, 45, 46, and others. Brief examination of the punching scores of Nos. 23 and 25 was of no help; they only duplicated the final scores, and earlier sketches will have to be examined for a fuller account. On the other hand, the punching scores to the studies following No. 40 were extremely revealing. Without these my information would have been far less specific, and many of the studies, from No. 20 on, will never be analyzed fully except by someone who has access to facsimiles of the punching scores.

Mind and heart in Nancarrow's music

Perhaps seventy percent of the appeal of Nancarrow's music, the reason it finds admirers among nonmusicians as well as composers, is its pure visceral energy, its combination of speed, melodic variety, timbral force, and clashes of tempo. Most of this book – Chapters 3 through 10 – will be devoted to the other thirty percent of his appeal: the compositional devices, the technical innovations, the formal insights, the ideas ready to flow into the future history of composing. Ad hoc systems appear often and are occasionally transferred from one piece to another, but Nancarrow, contemptuous of twelve-tone and similar methods, is not systematic in the sense that Schoenberg, Boulez, Stockhausen, and Babbitt are. As seemed appropriate for the first comprehensive study of a composer whose methods have been little understood, I have approached each study as a separate work with its own rules, and have tried to group the studies in such a way that restatement of the few transferable principles is minimized.

Given this book's concentration on ideas, technical devices, and structural achievements, it may be well to repeat what James Tenney has written about the other side of Nancarrow's work: "there is enough lyrical freedom, rhapsodic invention, and sheer fantasy to warm the heart of the most outrageously romantic 'intuitionist.'"¹⁵ In following chapters this conviction will be assumed without frequent emphasis. My interest is in how Nancarrow composes, and in the vistas he has added to the geography of musical form and contrapuntal technique. I have come to believe that once Nancarrow's achievements become widely understood,

he could eventually have an influence equal to that of Schoenberg, Cage, Stockhausen, or La Monte Young on how twenty-first century music is written. I also feel, however, that a compositional device lacks even anecdotal interest unless it is brought into being at the service of sincere expression.

The most affecting passages in the late Beethoven sonatas are the points at which compositional logic and emotional flow coincide, where a fugal theme suddenly appears in a natural but unexpected context, or where a long-prepared cadence quietly sheds its disguise and reveals itself as the recapitulated main theme. A successful short story is one in which the plot twists make the happiness and disappointments of the characters seem warranted and infectious. Likewise, a convergence point in a late Nancarrow canon is a riveting event, not because the numerical proportions used to achieve it were elegant, but because one hears the motives restlessly echo each other, grow shorter and shorter, pile up more quickly, draw into a sonic implosion, then release, relax, spread out, and die away into a rolling, interminable *ritardando*. Not only do you respond viscerally to the physical intensity of the sound – Nancarrow's pianos exude a remarkable energy, but anyone with an electric guitar can duplicate that level of enjoyment – you *hear* the process in its inexorable motion, you can tell with increasing specificity *when* it is going to happen, and you hear *why* it happens. Nancarrow is responsible for some of the most inwardly motivated climaxes in twentieth-century music.

The number proportions, tempo ratios, and compositional devices that fill the following pages may look forbidding, perhaps impressive, possibly irrelevant to ultimate questions of musical worth; but every one of them has as its purpose the efficient communication of an image. If Nancarrow's reputation depended on the complexity of his musical structures, he would have a line to wait behind, for many recent composers have spun circles around him in the convoluted analysis department. The measure of his achievement is that music so complicated in description sounds so vivid and direct. The music invites participation by the brain because it first made such intuitive sense to the ear.